WPAFB RADIATION SAFETY OFFICE
SHIPMENT QUALITY ASSURANCE CHECKLIST
Excepted Package

March 2004

Date: _____ **Shipper:** _____ **Destination:** _____

Item Description	Radionuclide	Activity Each	Number of Items	Total Activity

Radiation Package Survey Results: surface _____ **mrem/hr** **1 meter** _____ **mrem/hr**

Instrument Used: Mfgr: _____ **Model:** _____ **S/N:** _____ **Cal Date:** _____

Person Completing Checklist: _____ **Signature:** _____

EXCEPTED PACKAGE SHIPMENT

Yes No

☐ ☐ 1. Package meets general design requirements (see definitions). [173.421(a)(1) or 173.424(a)]
☐ ☐ 2. Package contains less than 15 grams of U-235. [173.421(a)(5) or 173.424(h)]
☐ ☐ 3. Activity less than §173.425, Table 4 (A_1/A_2 Quantity Limits are found in §173.435). [173.421(a) or 173.424(b&c)]

a. Limited Quantity: Permissible package limit: _____ Actual package activity: _____
b. Instrument or Article: Permissible package limit: _____ Actual package activity: _____
Permissible maximum article activity: _____ Actual maximum article activity: _____

☐ ☐ 4. Radiation level at any point on the external surface of package less than or equal to 0.5 mrem/hr. [173.421(a)(2) or 173.424(f)]
☐ ☐ 5. Removable surface contamination less than 2.2 dpm/cm^2 (alpha) or 22 dpm/cm^2 (beta/gamma). [173.421(a)(3) or 173.424(g)]
☐ ☐ 6. The outside of the package marked with the four digit UN identification number (i.e. UN2910 {LQ} or UN2911 {I&A}). [173.422(a)]
☐ ☐ 7. Full name and address of the shipper and consignee. [IATA 10.7.1.3.2]

Yes No N/A

☐ ☐ ☐ 8. For LIMITED QUANTITY ONLY, outside of the inner package or outside of package itself bears the marking "Radioactive". [173.421(a)(4)]
☐ ☐ ☐ 9. For INSTRUMENTS AND ARTICLES ONLY, the radiation level at 10 cm from any point on the external surface of any unpackaged instrument or article does not exceed 10 mrem/hr. [173.424(d)]
☐ ☐ ☐ 10. For INSTRUMENTS AND ARTICLES ONLY, the active material is completely enclose by non-active components (a device performing the sole function of containing radioactive material shall not be considered to be an instrument or manufactured article). [173.424(e)]
☐ ☐ ☐ 11. Permissible gross weight marked on package, if exceeds 50 kg (110lb) [IATA 10.7.1.3.2]

IMPORTANT: If you checked "no" to any item above, contact WPAFB Radiation Safety Office for further instruction.

COMMENTS:

Wright-Patterson AFB Radiation Safety Office

ACTIVITY LIMITS
INSTRUMENTS & ARTICLES and LIMITED QUANTITY
(49 CFR 173.425)

Radionuclide	NORMAL FORM			SPECIAL FORM				
	Instrument & Articles		Limited Quantity	Instrument & Articles		Limited Quantity	Exempt Limit (µCi)	Exempt Concentration (Ci/gm)
	Instrument Limit	Package Limit		Instrument Limit	Package Limit			
Americium 241	270 µCi	27 mCi	27 µCi	2.7 Ci	270 Ci	270 mCi	0.27	$2.7x10^{-11}$
Cadmium 109	540 mCi	54 Ci	54 mCi	8.1 Ci	810 Ci	810 mCi	27	$2.7x10^{-7}$
Cobalt 57	2.7 Ci	270 Ci	270 mCi	2.7 Ci	270 Ci	270 mCi	27	$2.7x10^{-9}$
Cobalt 60	110 mCi	11Ci	11 mCi	110 mCi	11 Ci	11 mCi	2.7	$2.7x10^{-10}$
Chromium 51	8.1 Ci	810 Ci	810 mCi	8.1 Ci	810 Ci	810 mCi	270	$2.7x10^{-8}$
Cesium 137	160 mCi	16 Ci	16 mCi	540 mCi	54 Ci	54 mCi	0.27	$2.7x10^{-10}$
Iodine 125	810 mCi	81 Ci	81 mCi	5.4 Ci	540 Ci	540 mCi	27	$2.7x10^{-8}$
Iron 55	11 Ci	1100 Ci	1.1 Ci	11 Ci	1100 Ci	1.1 Ci	27	$2.7x10^{-7}$
Krypton 85	270 mCi	2.7 Ci	270 mCi	270 mCi	2.7 Ci	270 mCi	0.27	$2.7x10^{-6}$
Nickel 63	8.1 Ci	810 Ci	810 mCi	11 Ci	1100 Ci	1.1 Ci	2700	$2.7x10^{-6}$
Plutonium 239	270 µCi	27 mCi	27 µCi	2.7 Ci	270 Ci	270 mCi	0.27	$2.7x10^{-11}$
Polonium 210	5.4 mCi	540 mCi	540 µCi	11 Ci	1100 Ci	1.1 Ci	0.27	$2.7x10^{-10}$
Promethium 147	540 mCi	54 Ci	54 mCi	11 Ci	1100 Ci	1.1 Ci	270	$2x10^{-7}$
Radium 226	810 µCi	81 mCi	81 µCi	54 mCi	5.4 Ci	5.4 mCi	0.27	$2.7x10^{-10}$
Tritium[1]	22 Ci	220 Ci	22 Ci	n/a	n/a	n/a	27000	$2.7 x10^{-5}$
Uranium (depleted)	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	Unlimited	$2.7 x10^{-14}$	$2.7 x10^{-11}$

NOTES:
1 These values also apply to tritium in activated luminous paint and tritium absorbed on solid carriers.

DEFINITIONS

General Design Requirements:

1. Easily handled and secured in or on conveyance.
2. If lifting attachment, designed with safety factor.
3. External surfaces free from protruding features and easily deconned.
4. Outer layer will avoid water collection.
5. Each feature added does not reduce safety of package.
6. Withstands conditions of normal transport including closing devices.
7. Materials physically and chemically compatible.
8. Values protected against unauthorized operation
9. For transport by air – a) temp. of surface will not exceed 50°C with ambient temp at 38°C, b) integrity maintained if ambient temp. at –40°C to 55°C, and c) liquids will not leak at pressure differential of not less than 95 kPa (13.8 lb/in^2).

Radioactive Instrument and article: Any manufactured instrument and article such as an instrument, clock, electronic tube or apparatus, or similar instrument and article have Class 7 (radioactive) material in gaseous or non-dispersible solid form as a component part.

Normal form: Radioactive material, which has not been demonstrated to qualify as "special form Class 7 (radioactive) material."

Special form: Radioactive material which satisfies: 1) single solid piece or in a sealed capsule that can only be opened by destroying capsule; 2) piece or capsule has at least one dimension not less than 5 mm; and 3) it satisfies test requirements of 49 CFR 173.469.

Contamination Limit: The amount of radioactivity measured on any single wiping material, divided by the surface area wiped and divided by the efficiency of the wipe procedure (may be assumed to be 0.10), may not exceed contamination limits

Exempt Limit/Concentration: Used to determine whether a given radioactive material is sufficiently radioactive to be subject to DoT HMR

NON-FIXED EXTERNAL RADIOACTIVE CONTAMINATION-WIPE LIMITS
(Averaged over 300 cm^2)
(49 CFR 173.443)

Contaminant	Maximum permissible limits		
	Bq/cm^2	uCi/cm^2	dpm/cm^2
Beta and gamma emitters and low toxicity alpha emitters	4	10^{-4}	220
All other alpha emitting radionuclides	0.4	10^{-5}	22

Swipe Evaluation (ADM-300):

$$\frac{Bq}{cm^2} = \frac{cpm\ (net)}{0.5 \text{ x } E_c \text{ x } 60\ \frac{\text{sec}}{\text{min}} \text{ x } A(cm^2) \text{ x } 0.1}$$

E_c = Probe Efficiency (AP-100 = 0.3 for ^{239}Pu; BP-100 = 0.45 for ^{90}Sr)
A = Area Swiped (300 cm^2)
0.5 = 2 Π to 4 Π geometry conversion
$cpm_{(net)}$ = Background subtracted from gross count
1 Bq = 1 dps or 60 dpm
0.1 = swipe efficiency

EXAMPLE:

$$\frac{Bq}{cm^2} = \frac{100\ \ cpm}{0.5 \text{ x } 0.3 \text{ x } 60\ \frac{\text{sec}}{\text{min}} \text{ x } 300\ cm^2 \text{ x } 0.1}$$

$$= \ 0.37\ \ Bq / cm^2$$